Return to play guidelines

Return to play guidelines after anterior cruciate ligament surgery

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Doctors should question whether return to high level pivoting sports is in the athlete's best interest after ACL reconstruction

"When can I play again, Doc?" is the emotionally charged, quintessential question asked by nearly every athlete after anterior cruciate ligament (ACL) injury. Invariably, the same question is one of the first asked by parents, team mates, coaches, and—in the case of the high profile athlete—the media. This implies that, to meet the expectations of the athlete and his/her surroundings, swift surgical intervention and accelerated rehabilitation becomes a priority. Therefore it is not surprising if the time to return to play is the standard by which orthopaedic surgeons measure themselves and are measured in sports circles.

Measured by this standard, sports medicine has made giant advances in ACL treatment programmes during the previous decades. We have progressed from open surgery to arthroscopic surgery, from extended casting to short term bracing, from conservative to accelerated rehabilitation programmes, and from long hospital stays to outpatient surgery. When an athlete is injured today, it is expected that arthroscopic surgery will take place a few weeks after injury, that rehabilitation is started immediately, and that the patient is able to return to sport in four to nine months. The "best" surgeons and physiotherapists are rumoured to return players even sooner.

> "Are there other criteria whereby we should measure treatment outcome than the time to return to sport?"

Lost in the need to succeed and with the fear of defeat deeply embedded in our decision making processes, it is no wonder that we rarely ask: "Is it time to quit? Is it safe to return patients to pivoting sports? What are the long term results of our treatment programmes? Are there other criteria whereby we should measure treatment outcome than the time to return to sport?" Should we not consider the risks of a graft rupture or additional knee lesions and the likelihood of the development of early osteoarthritis (OA) when advising the athlete after the initial injury.

To better address these issues, we have searched the literature for follow up studies after ACL injury examining the rate of return to sport, the reinjury risk, and/or the prevalence of OA (see table 1 for details on search terms and procedures). We have included studies of patients treated non-operatively or with reconstructive surgery who have been followed from 4 to 14 years after the initial injury.

RETURN TO SPORT AFTER ACL INJURY

For athletes who wish to return to pivoting sports, the typical advice is an ACL reconstruction after 4–8 weeks when full range of motion is established and there is no joint swelling.[1–3] The purpose of an ACL reconstruction is to give the athlete a mechanically stable knee and to reduce the risk of subsequent injury to the menisci and cartilage by reducing anteroposterior joint motion.[4] A number of short term studies have shown good to excellent knee function after reconstruction, whether hamstrings[5–7] or patellar tendon[8] grafts are used.[7] The same studies also confirm that most patients (65–88%) are able to return to sport within the first year. Thus it is fair to state that surgery is effective in allowing injured athletes to resume their sports career.

Also, some athletes are able to return to high level pivoting sports without surgery. Among patients treated non-operatively, the return rate ranges from 19% to 82% (table 1).[9 10] The athletes who successfully return to sport after non-operative treatment probably represent a selected group with functionally stable knees and a strong motivation to continue pivoting sport despite their injury.[11]

If athletes can return to sport with or without ACL reconstruction, how long are they able to keep playing after the initial injury? Most studies deal with ACL reconstructed patients, and the results vary between studies with a range from 8% to 82% (table 1). However, it is not always clear whether the authors are reporting an initial return rate or the proportion still playing at the time of follow up.[12]

Nevertheless, a few studies may be of particular interest, because they follow sports specific patient populations and report data on patients treated with and without surgery. Also, these studies mainly include elite athletes who can be assumed to be well motivated to continue their sports career. Thus the data may provide a realistic estimate of what to expect after returning to sport after injury. Myklebust *et al*[9] found in a 6–11 year follow up of ACL injured team handball players that 58% of the reconstructed players and 82% of the conservatively treated patients were able to return to their preinjury level.

In the 10–13 year follow up study with a mixed sport population, Fink *et al*[13] found a 44% reduction in high risk sports participation in the surgically treated group compared with a 70% reduction among the conservatively treated. In the longest follow up to date, von Porat *et al*[14] showed that, after 14 years, 6% in the operatively treated group and 1% in the conservatively treated group were still playing soccer. However, from these studies it is not possible to determine whether the players retired because of the injury or whether the retirement rate was higher than can be expected. Clearly, athletes may quit for reasons unrelated to their knee injury.

In the only study in which the reduction in sport participation can be related to a control group, Roos *et al*[10] reported on elite soccer players three to seven years after the ACL injury. They found that 30% were active in soccer after three years compared with 80% in an uninjured control population. In addition, they showed that, after seven years, none of the injured elite players were active regardless of the type of treatment. It seems fair to conclude that, although the initial return rate is high, regardless of treatment, previously injured athletes retire at a higher rate than athletes without previous ACL injuries. The reason for this may be that many of the athletes who return to sport experience significant knee problems, such as instability, reduced range of motion, and/or pain.[9]

REINJURY RATE AFTER SURGERY

One of the potential concerns with returning to sport is that the reinjury rate to the reconstructed ACL or to other structures (menisci, cartilage, or other ligaments)[15 16] may be unacceptably high.[17] Only few studies have examined

Table 1 Follow up studies on the rate of return to sport, risk of re-rupture, and the prevalence of radiological osteoarthritis after an initial anterior cruciate ligament (ACL) injury

Study	Material	Operative/Non-operative	Return to sport	Follow up (years)	Re-rupture	Osteoarthrosis	Remarks
Von Porat *et al*[14]	N = 205; age, 38 (30–56) Soccer male	89/65*	7.8% (9 op & 3 non-op)	14	–	78%** in both groups	*154 answered questionnaire **122 players with radiological exam
McDaniel & Dameron[32]	N = 50 (53 knees)	Non-operative	74%*	14	–	86%	*Returned to strenuous sport
Fink *et al*[13]	N = 71 (84%) in sports activity Skiing: 63%, Soccer: 24%	46/25	44% reduction in op/70% reduction in non-op*	10–13	0	78%/83%	*Reduction in high risk sports participation
Myklebust *et al*[9]	N = 79 (♂: 29, ♀: 50) Team handball	57/22	58%/82%	6–11	13% *	42%/46%**	*BPTB reconstructed **Radiological exam of 50 players
Drogset & Grøntvedt[21]	N = 100 (♂: 45, ♀: 55) Different sports activities	Reconstruction with LAD (n = 49) Without LAD (n = 51)	–	8	12%*	50%	*All occurred in pivoting activities
Roos *et al*[10]	N = 310 (♂: 213, ♀: 97) Soccer	157/153	22%/19%*	7	–	Not examined	None of the players played at the same level as before injury
Ruiz *et al*[33]	N = 30 (♂: 21/♀: 9) Football: 11 Rugby: 12 Other: 7	Reconstruction STG: 4 BPTB: 26	12 patients changed first choice sport*	7 (5–9)	3.3%	50%	*Change not attributed to knee pathology alone
Johma *et al*[34]	N = 59	BPTB	–	7	10%	57%	
Scavenius *et al*[35]	N = 33 (♂: 20/♀: 13) Mostly soccer, handball, alpine skiing	Non-operative	9%	7	–	Not examined	
Jennings *et al*[36]	N = 50 (♂: 32/♀: 18)	BPTB	32% same level, 94% lower level	5.2	–	Not examined	
Brandsson *et al*[28]	N = 102* (♂: 74/♀: 38)	BPTB	–	4–7	2.9%	Not examined	*The 3 players with re-rupture were excluded
Howe *et al*[37]	N = 83	BPTB	–	5	–	37%*	*Reported medial joint space narrowing
Pinczewski *et al*[38]	N = 180 (♂: 95/♀: 85)*	BPTB: N = 90 Hamstrings: N = 90	–	5	BPTB: 3% Hamstrings: 8%	12%**	*No information on sports participation. **BPTB: 18% Hamstrings: 4%
Otto *et al*[19]	N = 68 (♂: 49/♀: 19) Pivoting/side stepping sports	BPTB	38% preinjury level, 15% higher level	5	4.4%	24%	
Sandberg & Balkfors[18]	N = 112 (♂: 75/♀: 37) Different sports, soccer:72%	BPTB	35% returned to same level (soccer) 25% quit, rest only fitness training	5 (2–11)	9.8%	Not examined	
Ferretti *et al*[39]	N = 114	Hamstrings	67% same level 32% reduced participation 1 increased level *	5	–	25.4%	*No description of type of sports
Cooley *et al*[40]	N = 33	Hamstrings	45% maintained activity level 55% reduced activity level*	5	3%**	5%	*Not due to knee limitations **Was excluded from follow up together with patient with meniscectomy
Patel *et al*[41]	N = 32 (♂: 8/♀: 24) 88% from ''sporting activities''	BPTB	41%	5	9%	28%	
Wang *et al*[42]	N = 44 (♂: 32/♀: 12) 2/3 sports related	BPTB	–	4.8	–	61%	
Bak *et al*[43]	N = 132(♂: 117/♀: 15) Soccer	Hamstrings	68% same level 29% lower level	4	3%*	Not examined	*20% among females

A total of 540 papers were identified through a Medline search using the following key words: ''Anterior Cruciate Ligament/*injuries'' AND ''Follow-Up Studies''. Abstracts were reviewed to identify studies reporting on the return rate to sport, the reinjury rate, and/or the prevalence of osteoarthritis with a mean follow up period of at least four years. In addition, reference lists of selected papers were reviewed to identify additional studies. Follow up studies describing partial ACL ruptures or reconstructive surgery with sutures only were excluded. A single or double asterisk is used to indicate which piece of information the remark in the Remarks column is referring.
Op, Operative; Non-op, non-operative; BPTB, bone-patella-tendon-bone graft; STG, single strain gracilis; Hamstrings, includes semitendinosus, gracilis and iliotibial grafts; LAD, Kennedy ligament augmentation device.

reinjury risk, and they report a wide range of rerupture rates ranging from 2.3% to 13% (table 1).[18–20] The highest ACL rerupture risk (13%) was found by Myklebust *et al*[9] in their study of team handball players. However, one reason for the high risk seen in this study may be that team handball in itself is a high risk sport. Six of the 50 players who returned to team handball (9%) experienced an ACL tear in their contralateral, previously uninjured knee during the observation period.[9] A similar reinjury rate was reported by Drogset and Grøntvedt,[21] who found that 12% of their patients suffered a reinjury during an eight year follow up period, all during pivoting sports.

However, these results, as well as studies reporting lower rerupture rates, must be interpreted with caution. Firstly, the population at risk is not known, because it clearly depends on the proportion returning to sport and the number of years they continued to play. Secondly, bias must be considered when there is a significant loss to follow up as is evident in most of the studies. Thus, we do not know if there is an increased risk of reinjury to the reconstructed ACL compared with a healthy knee, nor do we know the rate of meniscus or cartilage injury associated with return to sport. Nevertheless, it is clear that nearly all of the reruptures reported in the papers shown in table 1 occurred while pivoting sports were being played.

> ''Returning to pivoting sport without a reconstruction results in considerable risk of injury to the menisci and cartilage''

Further damage to the knee with continued sports participation is of course also a concern in non-operatively treated patients. Myklebust *et al*[9] showed that 22% of the non-operatively treated players who returned to sport underwent additional surgery for an injured meniscus compared with 12% in the operatively treated players. Returning to pivoting sport without a reconstruction results in considerable risk of injury to the menisci and cartilage.

PREVALENCE OF OA

Using the rate of return to sports or even the reinjury risk as measures of treatment success may be grossly misleading. An ACL injury entails a significant risk of OA,[22] and it may be that the initial injury itself is an important determinant of the development of OA, no matter what treatment is used or how the knee is loaded during subsequent years.

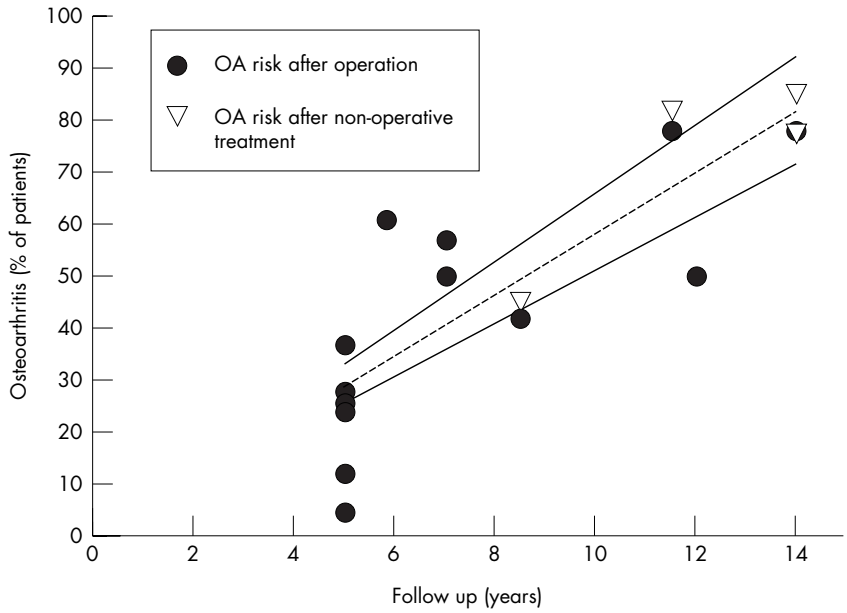

Figure 1 Anterior cruciate ligament (ACL) follow up studies and osteoarthritis (OA) prevalence. OA risk after both reconstructive surgery with bone-patella-tendon-bone graft or hamstring graft and non-operative treatment is shown. The dashed line indicates the forced regression ($y = 6.0\,t$; $r = 0.85$) between time (t) and OA prevalence (y), with the 95% confidence intervals shown by thin solid lines. Follow up studies describing partial ACL ruptures or reconstructive surgery with sutures only are omitted.

Another important factor is that isolated ACL injury is a rare occurrence. Bone bruises are evident in 80–90% of ACL injured knees, although their significance for future knee function is not clear.[23] Meniscal injuries are found in 75%,[23] and loss of meniscal tissue is an important risk factor for future degenerative joint disease of the knee. Other structures such as ligaments and capsular tissues—for example, the posterolateral structures—are often injured and may contribute to future OA. Assuming that treatment of ACL injury by reconstructing the ACL with tendon, repairing articular cartilage injuries with procedures forming fibrocartilage, and suturing the meniscus restores the knee to normality may not be true. After ACL injury, the biochemical markers do not return to normal even after many years.[24]

Also, sports participation in itself, even without a history of injury, results in a moderate increase in the risk of hip and knee OA.[25–27] Thus it seems reasonable to hypothesise that this risk would be exacerbated in a previously injured knee where joint motion and cartilage loading patterns are significantly different from the intact knee, despite proper rehabilitation or surgical intervention.[28 29]

Figure 1 shows the risk of developing radiological signs of OA with time after an ACL injury. After 10 years, approximately half of the patients display signs of OA. An extrapolation of these results indicates that nearly all patients will have OA after 15–20 years. A recent study showed that all athletes undergoing revision ACL surgery had OA when they were re-examined 37 (12–58) months after the reoperation[30] (because this study includes patients with two or more ACL injuries, it could not be included in fig 1 or table 1). It seems that a high frequency of radiographic changes is the rule rather than the exception after ACL injury.

These findings raise two important questions. Firstly, is there a difference in the risk of OA between surgically treated and non-operatively treated patients? Unfortunately, there are no prospective trials in which patients have been randomised to a reconstruction or non-operative treatment. In the three follow up studies that include surgically and non-operatively treated patients there may be a selection bias, which makes it difficult to interpret the results. Nevertheless, as shown in fig 1, the prevalence of OA does not seem to depend on whether an ACL reconstruction was performed or not. von Porat *et al*[14] reported 78% OA prevalence in both groups after 14 years, Fink *et al*[13] 78% *v* 83% after 10–13 years, and Myklebust *et al*[9] 42% *v* 46% after 6–11 years. Thus there is no evidence to suggest that ligament reconstruction prevents future OA.

The second question is: is there an increased risk of OA in athletes who return to sports compared with those

who choose to retire? For obvious reasons, there is no study in which athletes have been randomised to continued sports participation or early retirement. Furthermore, although it would have been interesting to compare OA prevalence between athletes who chose to retire and those who continued to play, these data have not been reported in the available studies. Therefore there is an urgent need to establish large prospective studies to follow cohorts of athletes with ACL injury. Using a multivariate approach, it will then be possible to assess the independent effects of treatment methods, associated injuries to the menisci and cartilage at the time of injury, graft choice, reinjuries, and continued sports participation, to mention a few factors that could be important for the development of early OA.

TIME TO QUIT

In 1970 Kennedy stated that ''the ACL is the most common cause of the ex-athlete.''[31] In other words, the treatment offered at the time did not permit athletes to go back to sport. This is no longer the case, at least in the short term, thanks to major advances in surgical treatment and rehabilitation programmes. As shown above, most elite athletes are initially able to resume their sports career. However, the data also show that the retirement rate may be higher among athletes with a previous ACL injury compared with healthy athletes. Furthermore, it is apparent that there is a significant risk of reinjury to the graft, as well as the menisci and cartilage with continued sports participation. Finally, there are convincing data to show that nearly all patients will develop OA with time.

Thus it seems reasonable to question whether return to high level pivoting sports really is in the athlete's best interest—if long term knee health is the primary concern. The relevant issue that needs to be addressed is: what are the additional risks of further injuries and early OA associated with return to sport? We cannot answer this question properly from the available data. Until we can, as physicians and physiotherapists working with this patient group, it is our obligation to provide adequate information of the potential consequences of returning to pivoting sports. We must enable the athlete to make an informed decision with all necessary information available, including the caveats related to future risk of knee problems and OA. This includes clearly pointing out that ACL surgery can only be expected to improve knee stability, but that ACL surgery does little or nothing to secure a future healthy knee. The answer to the question ''When can I play again, Doc?'' is straightforward and can be comfortably stated by most doctors: ''Probably within 1 to 9 months depending on the treatment that is best for you …'' BUT let us take a moment to talk about the more difficult question I am going to ask you: ''Should you return to sport?''

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